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NMR and AFM investigations of nanocavities on the double rare-earth fluoride crystal surface

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Abstract

Nanocavities with a size of less than 30 nm on the crystal surface of superfine LiYF4 powders and single crystals of the Van Vleck paramagnet LiTmF4 were detected by nuclear magnetic resonance (NMR) cryoporometry and atomic-force microscopy (AFM) and liquid 3He NMR cryoporometry. NMR investigations show that the nanocavities are evidently present on the surface of the LiYF4 powder particles. The distribution of nanocavities has two maxima corresponding to the specific porous sizes of 3-5 and 10-15 nm. AFM investigations detect the presence of the nanocavities with sizes in the range 50-300 nm on the surface of powder particles and single crystals. The cases of powder microparticles and of a single crystal differ in the value of the parameter "surface roughness", which is 14.5 and 11 nm, respectively. The mechanism of creation of nanocavities is proposed and verified by additional investigations with CaF2 powders.